



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT

Attorney Docket No. 401088

x In re Application of:

HU et al.

Application No.: 09/778,857

Art Unit: Unassigned

Filed: February 8, 2001

Examiner: Unassigned

For: THREE DIMENSIONAL
MEASUREMENT, EVALU-
ATION AND GRADING
SYSTEM FOR FABRIC/
TEXTILE STRUCTURE/
GARMENT APPEARANCE

CLAIMS PENDING AFTER PRELIMINARY AMENDMENT

1. A method of three-dimensional measurement, evaluation, and grading of fabric/textile structure/garment appearance, the method comprising :

with a fixed digital camera positioned above a piece of fabric, shining at least two different parallel light beams from inclined directions onto a surface of the fabric, capturing different reflected images of the surface of the fabric with the camera, analysing the reflected images captured to derive values of parameters of the surface based on intensities of light reflected from a number of evenly distributed points on the surface.

2. The method according to claim 1, including shining four different parallel light beams onto the surface of the fabric.

3. An apparatus for three dimensional measurement, evaluation, and grading of fabric/textile structure/garment appearance, the apparatus including:

a digital camera mounted above a piece of fabric,

means to shine at least two inclined different parallel light beams onto a surface of the fabric below the camera,

means for analysing images of the fabric captured by the camera, and
a computer programmed to derive values of P and Q from the images captured,
where P and Q are summations of surface gradients for a plurality of evenly distributed points in an x direction and in a y direction, respectively, on the surface of the fabric.

4. A method of grading fabric/textile structure appearance based on values P and Q, the method comprising:

using a fixed digital camera positioned above a piece of the fabric, shining at least two different parallel light beams from inclined directions onto a the surface of the fabric,
capturing different images reflected from the surface with the camera,
analysing the images captured to derive values of P and Q, where P and Q are summations of surface gradients for a plurality of evenly distributed points in an x direction and in a y direction respectively,
calibrating P + Q against a subjective grade analysis of the fabric, and
thereafter, using calibrated P and Q and determining the grade of the fabric.

5. The method of claim 4, including using four different parallel light beams.

6. The method of claim 4, in which the surface gradients p and q are derived from

$$\begin{cases} p = \frac{I_s E_w - I_w E_s}{I_s E_w + I_w E_s} \cdot \operatorname{tg} \alpha \\ q = \frac{I_n E_s - I_s E_n}{I_n E_s + I_s E_n} \cdot \operatorname{tg} \alpha \\ c = \frac{I_s \cdot \sqrt{p^2 + q^2 + 1}}{\sin \alpha + \cos \alpha \cdot p} \end{cases}$$

7. An apparatus for three dimensional measurement, evaluation, and grading of fabric/textile structure/garment appearance including:

a digital camera mounted above a piece of fabric,

means to separately shine at least two different inclined parallel beams onto a surface of the fabric below the camera,

means for analysing separate images of the fabric captured by the camera for each light beam, respectively, and

a computer programmed to derive values of parameters of the surface of the fabric based on intensities of light reflected from a number of evenly distributed points of the surface.

8. An apparatus for three-dimensional measurement, evaluation, and grading of fabric/textile structure/garment appearance according to claim 7, including means for separately shining four inclined parallel, different light beams evenly distributed with respect to the camera.